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ON INTUBATION AND THE USE OF DIPHTHERIA ANTITOXINE IN CROUP.*

BY

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The lesions which most frequently cause death in croup are stenosis of the larynx and its consequences, and a general toxemia. The former conditions are best treated by prompt intubation of the larynx; the latter, if the case be purely diphtheritic, by the early use of diphtheria antitoxine.

Laryngeal stenosis sometimes causes a sudden or a rapidly developed asphyxia, a veritable choking to death, but this is comparatively rare. A more frequent result, none the less fatal because gradually developed and less frightful to the friends, is a constantly increasing pulmonary embarrassment, due to a mechanical obstruction in the larynx which may appear trivial to a careless observer. Generally, the gravity of laryngeal stenosis and the necessity for its relief are to be measured by pulmonary symptoms; and in proportion as relief is afforded before defective respiration and its serious consequences become irremediable, the statistics of intubation improve and the general death-rate from croup diminishes.

With mechanical obstruction in the larynx, the upper portions of the lungs are more favorably situated for inspiration, the lower for expiration; hence distension occurs in the former and atelectasis in the latter. The diaphragm sinks, until in many cases it is as low as the eleventh or twelfth rib, and its respiratory movements are much diminished.¹ Thus the position of the diaphragm becomes a measure of the laryngeal stenosis. These mechanical obstacles to respiration and to pulmonary and bronchial circulation, with consecutive embarrassment of the heart itself, added to the effect of

vitiating blood upon the respiratory centres, all elements conducing to septic and inflammatory processes in the lungs, form a "vicious circle," an "endless chain," whose only "open link" is the laryngeal stenosis.

Intubation requires no defense at this day. It is discussed here for the purpose of emphasizing its indications and urging its early use. We should not regard it as a last resort, to be used only in desperate cases; on the contrary, it is a legitimate therapeutic procedure, which should be used promptly when the indications arise, just as the forceps are used in dystocia.

"When a progressive, unremitting dyspnea, despite all previous treatment, allows any considerable part of the posterior portion of the lungs to become non-inflated, when the labored breathing begins to produce sensible exhaustion, intubation is to be performed promptly. From this moment nothing but harm can come to the lung and heart. If air cannot be aspirated, blood will be; and pneumonia is invited." (W. P. Northrup.)

Tracheotomy is the elective operation in certain cases, but because intubation is intrinsically the better operation, is less repugnant to parents and therefore more available, it is rapidly supplanting the former. Stern's¹ summary of the relative indications for these two operations is no longer entirely applicable, in the light of later statistics. The statistics of intubation constantly improve, and when once the rank and file of the profession are properly alive to the necessity for intubating before the child is moribund, this improvement will be still greater. More efficient

¹ Cnopf, of Nuremberg. *Münchener med. Wochenschrift*, May 8, 1894.

¹ Max Stern. *Trans. Ninth International Med. Congress*, vol. iv, 1887.

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medical treatment has also contributed somewhat to the improvement in statistics. Unaware of Bouchut's failure in 1858, O'Dwyer, in 1880, began the experiments which led him to the perfected operation of to-day. In 1888 Waxham collected and reported 1,027 cases intubated, with 26.77 per cent. of recoveries. Within the last two years seventeen¹ observers have reported 2,728 cases with 37.4 per cent. of recoveries. Von Ranke² collected and reported, in June, 1894, 1,445 intubations, with 38 per cent. of recoveries. Dillon Brown reported 218 intubations done on cases treated by sublimations of calomel, with 39.9 per cent of recoveries. Some operators of large experience now show even better results, but these averages, made from large numbers of cases, collected from many parts of the world, occurring under diverse circumstances and in the hands of many physicians, probably show what may be expected from the operation when associated with ordinary medical treatment.

While intubation should be more general, it is not advisable that the operation be attempted by one without special training or practice upon the cadaver. O'Dwyer advises the physician who is without training and beyond the reach of experienced operators, to do tracheotomy instead. I can assure you it is not always readily learned, nor is self-confidence the sole requisite for its proper performance. It presents many difficulties whose ready and skillful solution add much to the percentage of recoveries. Many accidents and complications, which were formerly supposed to be inherent in the operation, are now known to result from lack of dexterity and judgment in the operator.

Better than treating laryngeal stenosis, is its prevention, where that is possible. Fumigation with the vapor from sublimated calomel has given good results. Quoting from McNaughton and Maddren, who collected statistics

from 242 physicians throughout the country, Dillon Brown¹ reported 505 cases of "true croup" treated by "sublimations." Of 420 which were not operated, 174 died, or 34.5 per cent. of the whole 505 cases. Of 85 operated cases, 56 died, or 11 per cent. of 505. Total deaths in 505 cases, 230, or 45.5 per cent.

The internal administration of calomel or of bichloride of mercury has been extensively used within a few years, with good results. Through personal curiosity, I collected the few cases of croup treated within five years by three neighbors and myself. Such small numbers have no value as general statistics, but because the cases appear to show the comparative value of the treatment by bichloride of mercury I venture to report them.

Of 8 reported as "membranous croup," 5 recovered, 3 died; of 20 reported as diphtheritic croup, 13 recovered, 7 died.

Of 14 in which the pharynx was involved, 7 recovered, 7 died; of 14 in which pharynx was not involved, 11 recovered, 3 died.

Of four intubated cases, 3 recovered, 1 died; 1 tracheotomized patient died.

Of 17 treated with bichloride of mercury, 13 recovered, 4 died; of 11 not so treated, 5 recovered, 6 died.

I am well aware that eleven recoveries in the fourteen cases in which the pharynx was not involved will call the diagnosis into question. Of this eleven which recovered, two were intubated, a third expelled a tubular pseudo-membrane, and three others were in one family. Of these three cases, occurring in children aged four and one-half years, two and one-half years, and seven months, the first was severe, the child expelling a fragment of membrane; the second and third occurred at the same time, seven days after the first began. I made a culture from the second case, and Dr. Henry W. Bettman, Bacteriologist to Cincinnati Hospital, reported both staphylococci and Loeffler bacilli present. The three recovered without operation, under the administration of bichloride of mercury. The fourteenth

¹ Fifteen quoted in Sajour' Annual, 189J. G. Bieser, Archiv. Pediatrics, 1895, xii, p. 99. W. A. Morrison, Boston Med. and Surg. Journal, 1895, cxxxii, p. 127.

² Jahrbuch für Kinderheilkunde, Leipzig, June 15, 1894.

¹ Med. News, May 12, 1894.

case has just recovered, after ten days' illness. The girl, aged seven years, was attacked by diphtheritic croup at the same time an older sister contracted pharyngeal diphtheria. The two cases were preceded by a case of pharyngeal diphtheria in the same family, ten days before. Within forty-eight hours the stenotic breathing was well marked, noisy, constant, not marked by paroxysms, and persisted for five days. Laryngoscope showed slight deposit on lower part of posterior aspect of epiglottis. I could not get satisfactory view of larynx. Intubation was not done because pulmonary symptoms did not demand it, although the breathing was labored and ranged from 28 to 35. These clinical notes may perhaps support the diagnosis in seven of the eleven cases which recovered.

Croup following pharyngeal or nasal diphtheria is primarily a local disease in the larynx or trachea, resulting by direct extension from the pharynx, or from pathogenic organisms which have been inspired. Frequently it is not marked by thickness and rapid development of the pseudo-membrane, because the specific organisms are growing upon a soil made unfavorable to them by an immunity acquired during the preceding diphtheria. Evidently a limited local process is followed by less than the usual general toxemia, and such poisoning as may occur is less serious because of the immunity mentioned. In short, acquired immunity modifies the very two conditions which most frequently kill in croup.

Theoretically, the prompt administration of a reliable antitoxine in pharyngeal diphtheria will diminish the probability of croup as a complication, and will favorably modify that disease when it does occur. It should also give good results when administered early in cases of croup not preceded by diphtheria elsewhere. A study of the large amount of clinical data now available shows that diphtheria antitoxine does practically all that may be reasonably expected of it. It does not act chemically and is not to be regarded as an antidote to a poison. It has practically no effect on the local disease-process already present. It does, how-

ever, produce a tolerance toward the specific toxemia, so that in many cases within twenty-four hours the patient is in a convalescent stage, so far as the constitutional condition is concerned. It "takes care of the patient" while the local disease is treated. It does not influence the activity of various pyococci, and does not prevent general septicemia. Indeed, it is less effective in mixed infection than in pure diphtheria. Whether it be possible to render animals immune to the various cocci, as well as to the Löffler bacillus, and thus produce a mixed antitoxine, remains to be seen. Reports of Prof. Marmorek and other experimenters appear to be somewhat encouraging.

Prof. Welch publishes in the July-August number of the *Bulletin of the Johns Hopkins Hospital* an exhaustive paper on "The Treatment of Diphtheria by Antitoxin," which is candid and convincing. The paper is based upon the collective statistics of 7,166 cases of diphtheria treated by antitoxine, reported by eighty-one observers in all parts of the world, none of whom report less than ten cases, and many of them report hundreds. Forty-one observers, reporting 4,294 cases of diphtheria, report 1,167 operations for croup in such form that they may be used for comparative study. Use now as a basis for comparison the average mortality after intubation in this country (perhaps 65 per cent.), the mortality of Von Ranke's 1,445 intubations done in Germany before the days of antitoxine (62 per cent.), and the average simultaneous mortality of intubated cases not treated by antitoxine, as given by the reporters of 760 operated cases in Welch's table (62.4 per cent.), and the mortality of 342 intubated cases treated by antitoxine (28.9 per cent.) is very striking. The mortality after intubation was apparently reduced 49.5 per cent. by the conjoined use of antitoxine. One thousand one hundred and sixty-seven cases, severe enough to require operation, occurring in connection with more than seven thousand cases of diphtheria, receiving the same specific treatment under varying circumstances of climate, nationality, nursing and hygienic surroundings, yet showing a mor-

tality one-half the death-rate under any form of treatment heretofore known, challenge attention.

A number of observers quoted by Welch state that under its use croup less frequently complicates other forms of diphtheria, is less severe, does not so frequently demand operation, and shows a remarkably low death-rate after operation.

These 1,167 cases do not include all the croup treated—merely those cases which were operated upon, the more serious ones. It is not possible to determine from Welch's tables the entire number of cases of croup treated. Kossel, von Widerhofer, von Ranke, Vierordt, Ganghofner, Bokai, d'Espine, and Moizard and Perregaux report the entire number treated by antitoxine, giving both the operated and non-operated cases. Their collective statistics are as follows:

Total cases treated, 546.

Recovered without operation, 199.

Died without operation, 0.

Required operation, 347, or 64 per cent.

Died after operation, 134, or 38.6 per cent.

Total deaths in 546 cases, 134, or 24.5 per cent.

Since the average death-rate after operation of these nine observers (38.6 per cent.) is but slightly greater than the average mortality of the entire 1,167 operated cases (37.2 per cent.), it is fair to suppose that the entire thirty-eight reports contain as large a proportion of cases recovering without operation. If 1,167 operated cases represent but 64 per cent. of the croup treated, the entire number was about 1,811. The thirty-eight observers report 434 deaths after operation. On the supposition that all of them operated as promptly as the nine before mentioned, and permitted none to die without operation, 434 deaths would represent the entire mortality from croup, 23.9 per cent of the entire 1,811 cases. Even if we suppose the mortality in unoperated croup was as great as the average mortality (11.2 per cent) in the 3,127 cases reported as non-operated diphtheria, and add fifty deaths to the 434 in operated cases, the total deaths from croup would be 484, or but

26.7 per cent. of the entire number treated.

Since intubation combined with antitoxine gave better results than did tracheotomy, and also showed a greater improvement over the average mortality in cases not treated by antitoxine than did tracheotomy, the mortality deduced is slightly higher than it would have been had all the operated cases been intubated, because about two-thirds of the operations were tracheotomies. The tables teach that the mortality of croup, under antitoxine treatment with intubation when indicated, is not far from 25 per cent.

It is no longer a tenable argument to say that the cases treated by antitoxine are mild, occurring during an epidemic of minimum severity. Undoubtedly the severity of diphtheria varies, yet we cannot conceive a period of time, beginning promptly with the introduction of antitoxine and continuing more than a year, when the cases are simultaneously mild throughout the world. Whether or not the administration of serum ever produces remote evil after-effects, is perhaps still in doubt. It has certainly never been proven that it does. The same candor which demands that claims in behalf of serum-therapy be supported by large numbers of observations, in order that accidental variations and other causes of error in small statistics be eliminated, requires that adverse criticisms be supported by a respectable array of facts. Counting the red blood-cells in a few cases is not conclusive. After making over one thousand autopsies upon children dying of diphtheria before the days of antitoxine, Kolisko reported upon the post-mortem condition of the various organs from seventy-five cases dead of diphtheria after antitoxine treatment. He positively denies that there are found any lesions not found in cases which have not received the serum.

No evil after-effects have immediately followed, except in a few cases where the material or the method of its administration were justly suspected; and as a reliable antitoxine is used with increasing skill, in efficient doses earlier in the disease, the statistics constantly improve.

